Royal Netherlands Institute for Sea Research

Testing Ballast Water Technologies

a challenge for marine research in the Netherlands

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outline

- Introduction of *Royal*-NIOZ and history BWT activities
- Why is NIOZ so unique for land-based testing
- Collaborating partners
- Mission of academic research institute in BWT testing
- Standard-D2, CA and the NIOZ approach
- Results (Hamann AG, Ecochlor & Hyde-Marine/LAMOR)
- Future plans

- Representing view of NIOZ and not necessary of NA's

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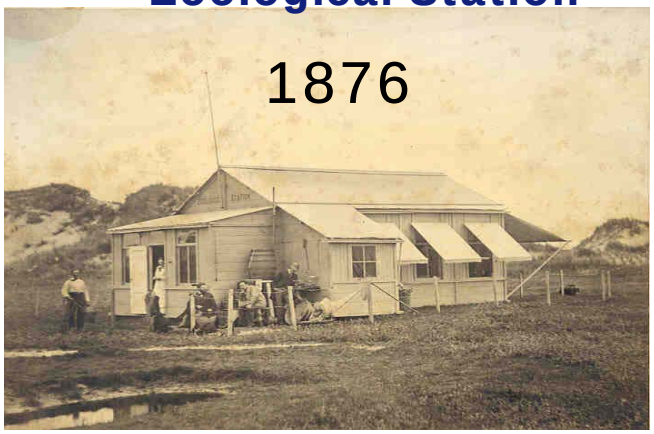
Zoological Station



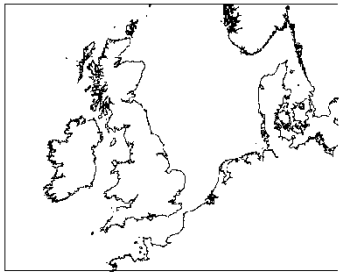
Texel - NIOZ

Den Helder - Zoological Station / NIOZ

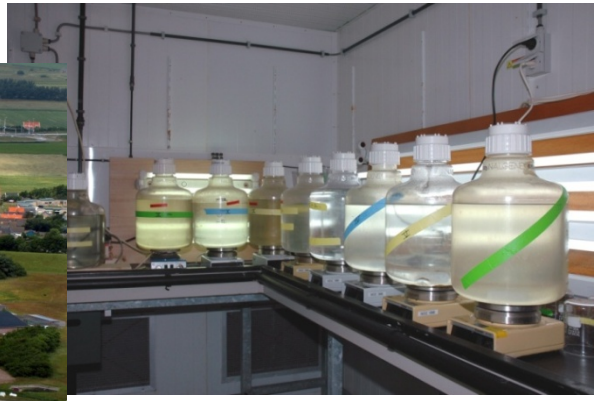
2007

Why is NIOZ so unique for land-based testing

- testing since 2004; 2007 & 2008 Final/Type Approval tests
- 3 test series for Certification by NA, 16 companies pilot studies
- Tidal system with coastal water varying in salinity (24 – 30 PSU) and turbidity (10 - > 100 mg/l)
- Organisms diversity > 50 different species belonging to numerous genera



Why is NIOZ so unique for land-based testing



Why is NIOZ so unique for land-based testing

Why is NIOZ so unique for land-based testing

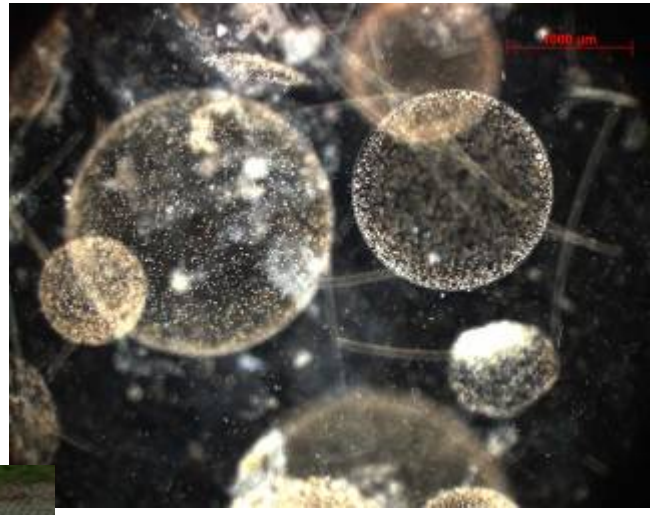
Why is NIOZ so unique for land-based testing


Hyde GUARDIAN


MAHLE NFV
OPS
STAMMIS
STAMMIS VERHUUR B.V.
TER TREATMENT

Why is NIOZ so unique for land-based testing

The ultimate challenge: treating huge blooms of slimy phytoplankton



Partners

- Bundesamt für Seeshifffart und Hydr. German administration
- Marine Coastguard Agency (MCA)
- Dutch Min. Verkeer & Waterstaat (NL),
- Lloyds Register (London, Rotterdam),
- TNO-Imares, AquaSense (toxicology studies),
- VITENS (human pathogens)
- CaTO Marine Ecosystems Research and Manage
- KiTe ARC, GoConsult
- US-Coastguard
- NL-Royal marines
- GSI
- IMO/GESAMP

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Mission academic research institute in BWT testing

- Public organization bound to publish all research in international peer reviewed journals
- Developing generic and specific tools and technologies
- Viruses, bacteria, phytoplankton and zooplankton (life stages)
- Holistic approach multiple tools to asses numbers and viability, applying state of the art tools and technologies
- Critical review of G8/G9 and legal aspects,
- Fundaments for future legislation based on acquired data
- Specialized studies of ‘silver bullets’

Mission academic research institute in BWT testing

- holistic approach multiple tools to asses numbers and viability

  Microscopic counts (time consuming)

  FlowCam; semi-automated (larger organisms)

  Flow cytometry; automated (smaller organisms), including <10 µm

  (phytoplankton, bacteria, viruses)

- viability of remaining organisms but also vitality of discharged water

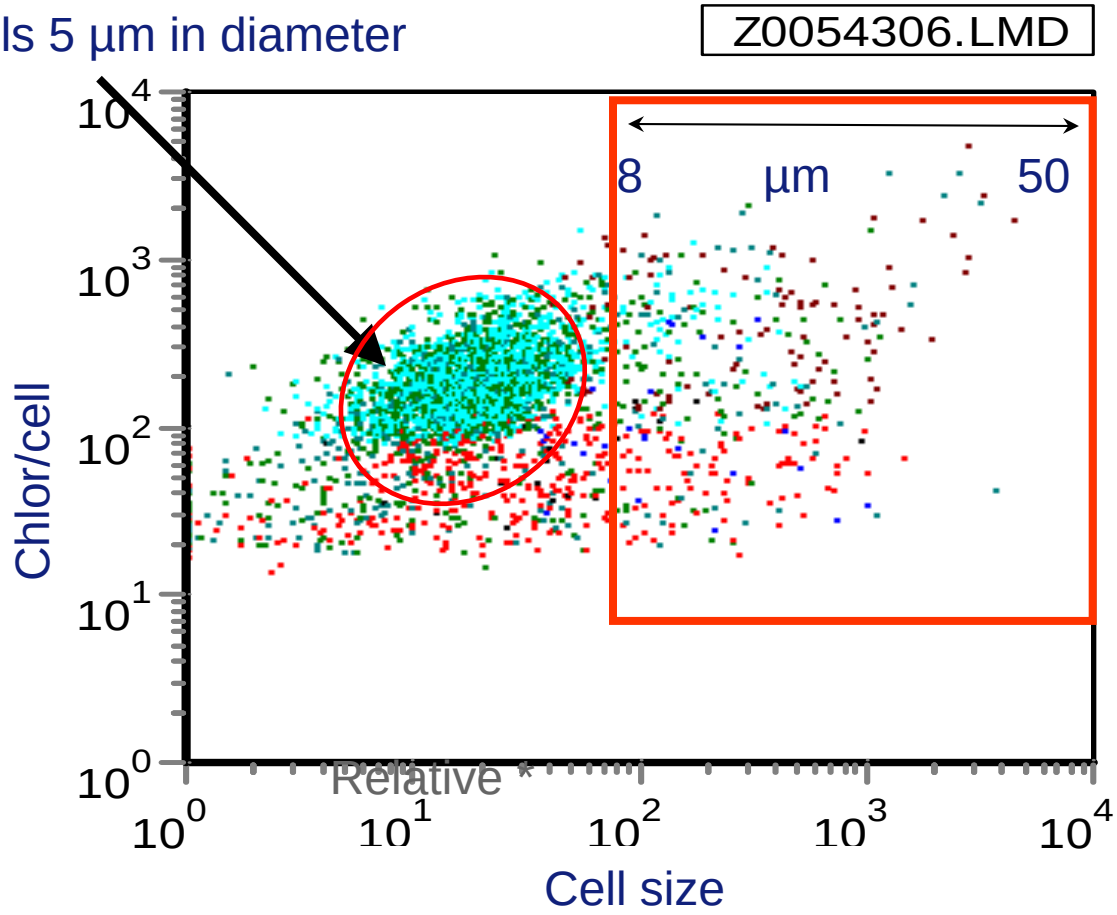
Standard-D2, Ballast water management Act (US), CA-standard and the NIOZ approach

Management approach	IMO Standard-D2	BW management -Act	2008 California Standard	NIOZ	nature
Org. > 50 µm	< 10 viable/m^3	< 0.1 viable/m^3	0 (/m^3?)	n.d.	10^2-10^5/m^3
Org. 10- 50 µm	<10 viable/mL	< 0.1 viable/mL	< 0.01 viable/mL	n.d.	10-10^4/mL
Org. < 10 µm (phytoplankton)	-	-	-	n.d.	10-10^6/mL
Bacteria	-	-	< 10 cfu/mL	-	10^5-10^8 /mL
viruses	-	-	< 10^2/mL	-	10^4-10^8 /mL
n.d.= non-detectable		- = no standard			

The forgotten fraction: Org. < 10 µm (phytoplankton)

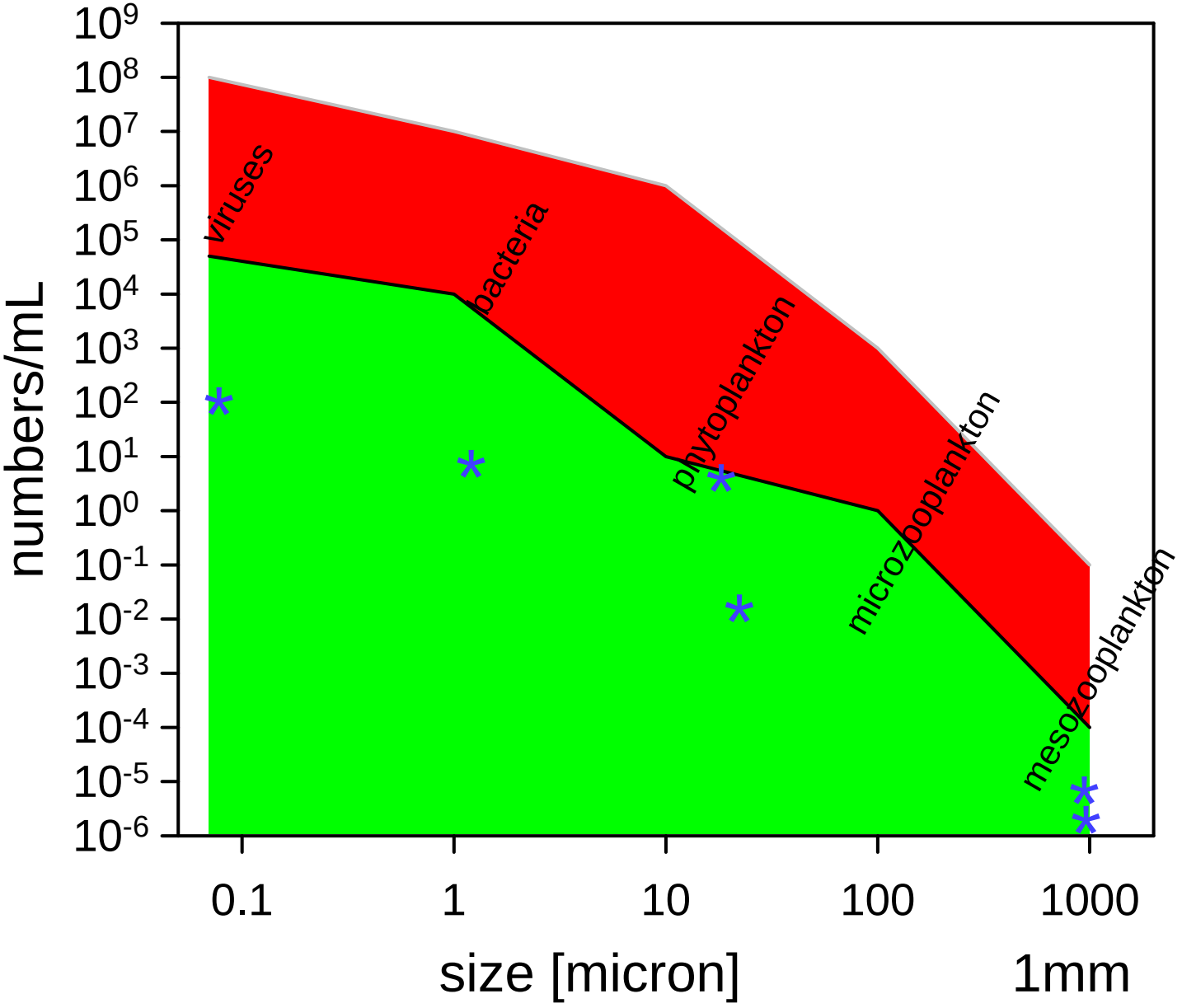
Large number [± 40,000/ml]

of phytoplankton cells 5 µm in diameter



A lot more phytoplankton cells than the size range of interests !!!!

Sample before treatment


numbers/mL
10^{9}
10^{8}
10^{7}
10^{6}
10^{5}
10^{4}
10^{3}
10^{2}
10^{1}
10^{0}
10^{-1}
10^{-2}
10^{-3}
10^{-4}
10^{-5}
10^{-6}
viruses
bacteria
phytoplankton
microzooplankton
mesozooplankton
0.1
1
10
100
1000
size [micron]
1mm

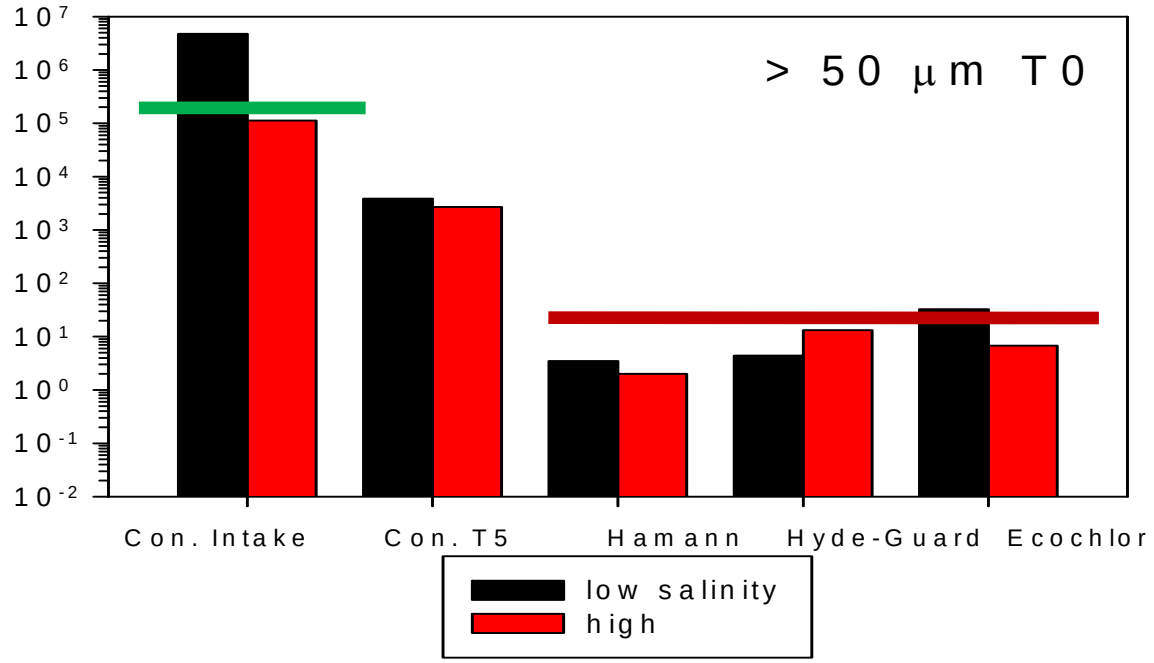
Results: Interactions with stakeholders

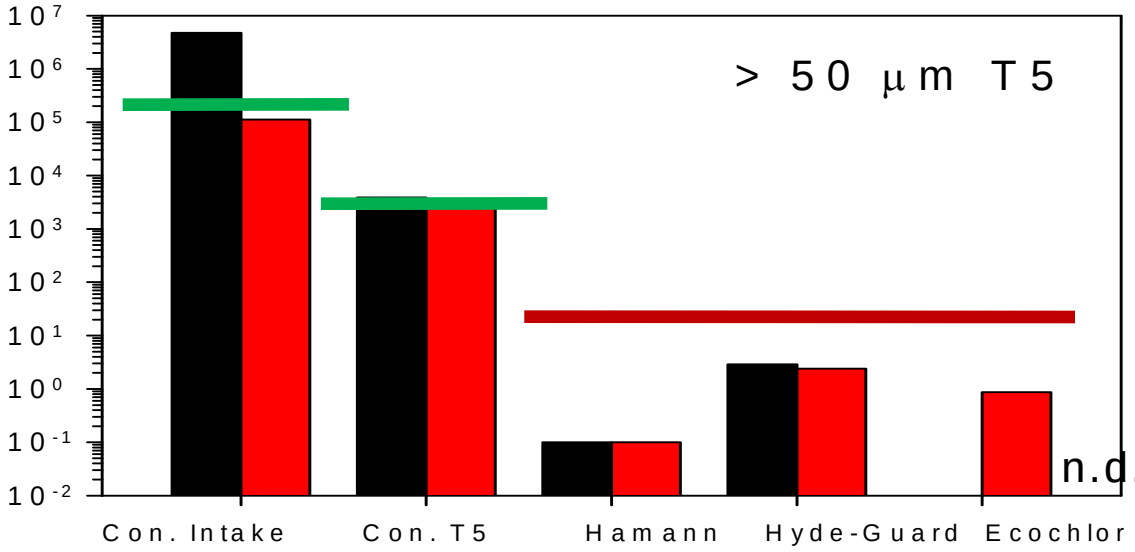
- Intermediate between national administrations/IMO/ industry
- Define protocols for certification; required documentation, conducting land-based testing, data reports (ex/internal review)
- Legal aspects; transparent and sound data to be transferred into legally defendable results
- Trying to harmonize the requirement of different NA (Who is pushing the ON and OFF buttons)

Results: Interactions with stakeholders

- Improve and expand present set of (multiple) test protocols (active substances)
- Compare present standard(s) with current achievements
- legal/statistical aspects of numbers and sample volumes
- (semi)automated analysis
  - TSS,POC,DOC, turbidity, salinity ~ 400 samples
  - Life -microscopy (> 10 µm) ~ 120 samples
  - Phytoplankton (PAM, FCM, micro) ~ 500 samples
  - Bacteria (counts, hum. Path.) ~ 500 samples
  - Viruses ~ 250 samples
    - Total **~ 1770 samples**

Test results SEDNA-Hamann Hyde-Guardian Ecochlor





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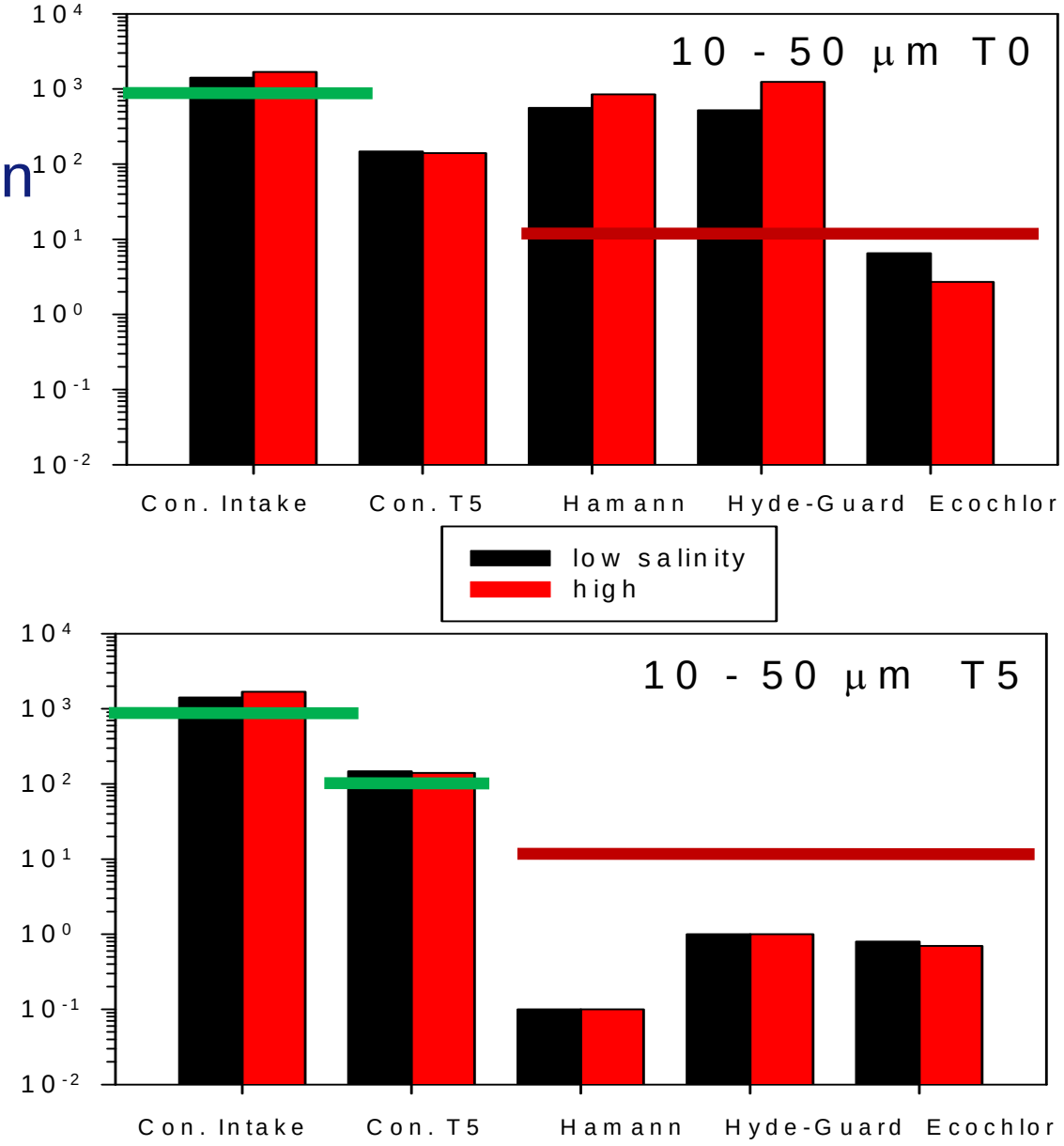
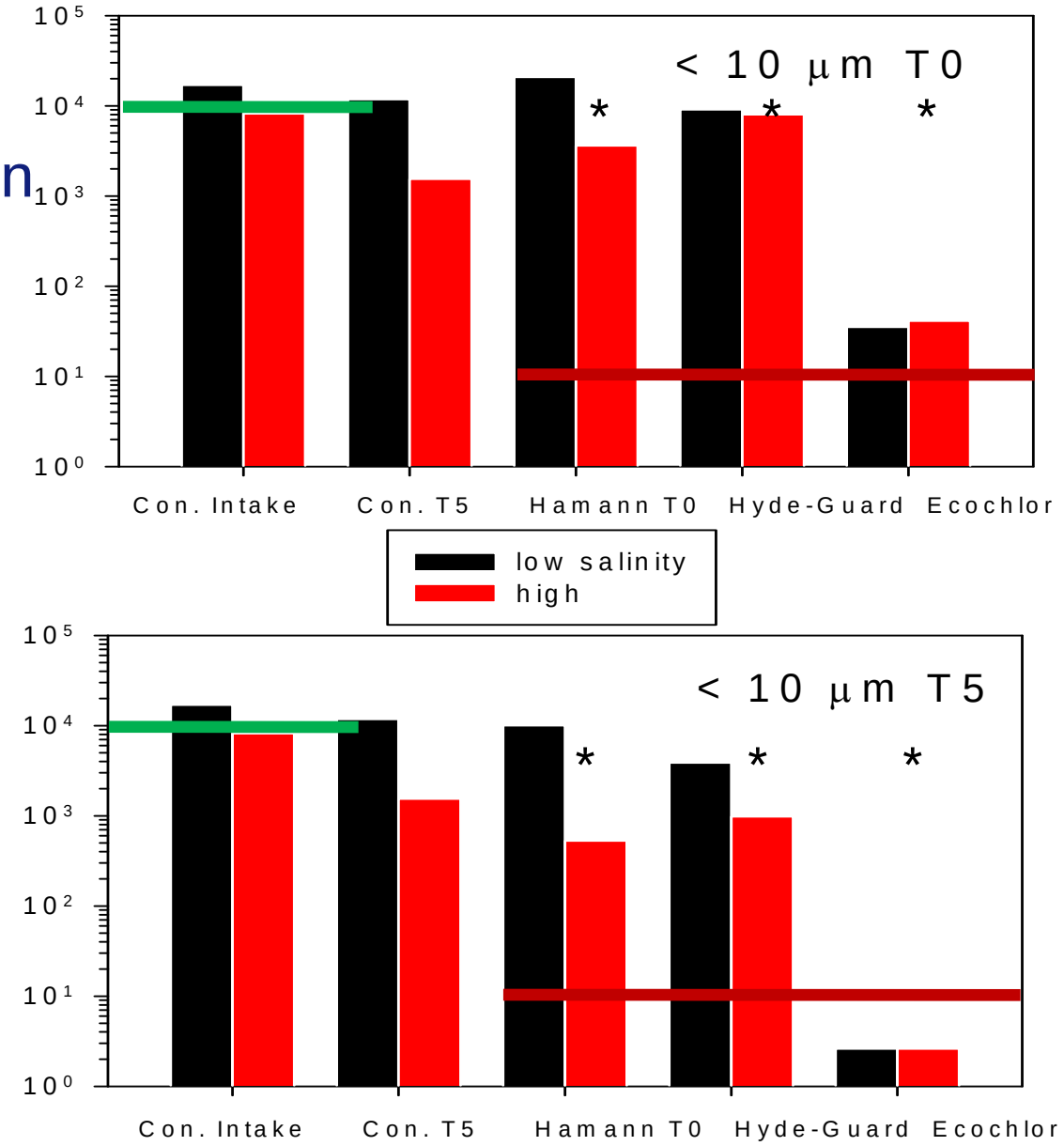


Test results SEDNA-Hamann Hyde-Guardian Ecochlor

~ bacteria standard



* = non-viable

Future plans

- Search for (innovative) tools addressing numbers & viability
- Test bed for innovative BWT technologies
- Transfer of academic knowledge into legislative process
- tools for examining efficacy of BWT systems, research regarding tools for compliance enforcement and monitoring (EU-project submitted; EU-Interreg North Sea)

acknowledgements

- Frank Fuhr
- Peter-Paul Stehouwer
- Eveline Garritsen
- Anna Noordeloos
- Swier Oosterhuis
- Jolanda van Ieperen
- Jan van Ooyen
- Karel Bakker
- Eveline van Weerlee
- Santiago Gonzalez
- Matthias Voigt
- Bernd Hopf
- Rolf von Ostrowski

Karin Sigel
Graham Greensmith
Tjitse Lupgens
Dick Brus
Brain Elliot
Tom Mackey
Tom Perlich
Matt Granitto
Jukka Sassi
Marcie Merksamer
Christian Terrientes
David Wright
Cato ten Hallers

Kai Trümpler
Klaas Kaag
Lothar Reincke
Andreas Meinhardt
Matthias Welle
Michael Volkmer
Siem Groot
Rober Lakeman
Mike Hasson
Daniel Olson
Al Francisco
Jan Boon
Angeligue Metz

there is no wisdom without ballast